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Real Time Vehicular Routing and Traffic Guidance System

Abstract

The invention provides real time information on the flow of vehicles on all roads within territorial boundaries, utilizing GPS enabled cell phones or similar mobile devices as traffic probes. The resulting information is submitted to subscribers, as described infra, and used in multiple applications including, but not limited to, real time vehicle routing; emergency vehicle routing; roadside emergency services requirements indication; traffic management; public agency notification of reduced vehicle flow on roadways; and real time as well as historical flow patterns to agencies responsible for maintaining or designing roads for optimum traffic flow.

The term 'subscribers', as described herein, shall include, but not be restricted to mobile transceiver operators, such as cell phone or GPS enabled display panel users, Internet-enabled computer users, and users of PDAs (personal digital assistance devices), or such other entities as public agencies or the like.

The invention describes a system and Method to capture, measure, analyze, and describe a traffic condition in a plurality of predefined grid segments, and supply to a subscriber base multiple levels of services consisting of, among others, alerting subscribers of impending traffic jams, alternatively supplying subscribers via cell phones, vehicle based map display panel, or via the Internet, LANs or WANs, with routing instructions for a subscriber specific route segment (Fig. 1) beginning at node $Long^1/Lat^1$ and ending at node

$Long^2/Lat^2$ (Fig. 2), or for a set of route segments contained in a subscriber specific, or default stored matrix of routes, beginning at node XY^1/XY^1 and ending at node XY^2/XY^2 (Fig. 2), following a maximum flow algorithm known, for example, as Ford-Fulkerson, Dijkstra, or similar algorithm.

Furthermore, the invention describes a system and method to measure in real time highway traffic in segments, or subsegments, including variable subsegments, ahead of highway entranceways and use the data derived from such measurements to directly control the cycle and length of traffic lights controlling access to the highway (Fig. 6).

Prior Art

5,745,865 Traffic control system utilizing cellular telephone system

5,465,289 Cellular based traffic sensor system

5,402,117 Method of collecting traffic information, and system for performing the method

5,182,555 Cell messaging process for an in-vehicle traffic congestion information system

5,043,736 Cellular Position Locating System

6,150,961 Automated traffic mapping

5.933.100 Automobile navigation system with dynamic traffic data

Description

The invention describes a system, incorporating at least one wireless data receiver, capable of receiving from a plurality of participating transmitters, for example GPS enabled cell phones, such data as is required for determining the transmitter identification code, a sign-on code, an optional routing code, describing a selected matrix of preferred and alternative routes (for example home to work), if any, and the location of the transmitter.

The system furthermore incorporates means capable of (1a) either pinging the subscriber's transmitter, as needed to obtain a current location, or (1b) alternatively deriving transmitter specific ID codes, time and location parameters from subscriber specific parameters transmitted periodically in intervals by the participant, for example a cell phone user; (3) comparing said stored parameters with the currently received parameters; and (4) calculating the velocity of a transmitter by comparing previous and current location data, (5) submitting to the subscriber's receiver, PC, PDA, or mapping device, either wireless, by fixed wireless means, or via LAN's, WANs' or Internet, such information as requested or subscribed to, including impeding traffic conditions ahead of the subscribers probable route, and instructions for routing of a subscriber's vehicle through least-impeded segments on a subscriber's selected matrix consisting of at least one route.

The invention furthermore incorporates such logic as is required to measure, analyze, compare, write into, or retrieve traffic conditions relating to a segment

(Fig.1) contained in a matrix of route segments (Fig. 2) from a record incorporated in a data base, as described as an example in more detail in Fig. 3. Nothing herein shall be construed to exclude variations in the proposed logic.

The said logic is especially capable of capturing location data from a participant, whether a subscriber or not, storing all or part of that data - together with the transmitter identifier in an encrypted form - temporarily in a data base, recapturing the location data with the previously recorded transmitter location in intervals of n seconds, comparing the previous location with the current location and calculating from the analyzed latitude/longitude location information the velocity of the transmitter(s). The said logic is capable of thereafter erasing the previous data and storing instead the current data in the temporary database for further analysis, so that only the latest data is stored.

The logic is specifically capable of probing the location of a plurality of subscribers in the same segment, determining their respective driving direction, average speed, thereby applying principles of fuzzy sets and logic to determine multiple lane speed differences, and calculating the maximum traffic flow for each direction of each segment and optionally each lane within that segment.

The logic is furthermore capable of thereafter storing that data as n-bit word containing segment identifiers, segment descriptors, max flow values for one direction, max flow values for the opposite direction, average velocity values,

lane specific velocity data, and Bezier Curve data for an accurate description of the segment, including its true length. Figs. 4 and 5 provide a fair description of the process logic for a preferred form of the invention. Nothing herein shall be construed to imply that the examples, given in Figures 3 through 6, are exclusive.

The proposed system specifically addresses the issue of privacy by encrypting the subscriber ID, storing the encrypted subscriber ID temporarily in a database accessible to the system only, and erasing any data identifying the subscriber upon completion of a measuring cycle, unless the subscriber opts in by requesting service for which the subscriber ID is required, such as the retrieval of stored matrix data, or real time traffic alerts.

The invention furthermore describes a method to inform a subscriber of traffic conditions on demand by cell phone, or other device, including PDA and computer, whereby flow-impeding traffic conditions ahead of the subscriber's probable route are submitted automatically to the subscriber's cell phone by voice or by cell phone beeper code.

In an alternative expression of the invention, the subscriber can submit a code, for example **'Star 5',** to access a predefined grid of route segments, stored in the system, to obtain routing instructions for his way to work from home or vice versa, wherein the system calculates maximum flow conditions using, for example, the Ford-Fulkerson, the Dijkstra, or a similar algorithm, and submits to the subscriber the fastest routing alternative within a subscribed or selected matrix (Fig. 2), beginning at XY^1/XY^1 and ending at XY^2/XY^2 . The benefits of

pre-stored subscriber specified routing grids consists of a significant decrease in computational requirements, compared to a system in which the route beginning at node $Long^1/Lat^1$ and ending at node $Long^2/Lat^2$ has to be selected out of the full service area every time a demand for service is submitted. Furthermore, for the purpose of data mining, the system allows a detailed analysis of at least the average speed encountered per segment and hour, day, month, and year. Such statistical analysis is valuable for public agencies, for example State agencies, which have to plan road construction and maintenance.

Moreover, the system's traffic data collection technology is optionally used to measure traffic conditions, i.e. traffic velocity, traffic density, and lane conditions within a segment or subsegment ahead of a regulated entranceway, as shown in Fig. 6. In conjunction with a traffic control device, located in the entranceway, the proposed method directly influences the frequency and length of the green cycle of said traffic control device, thereby adapting in real time highway access through the entranceway to spontaneous highway traffic fluctuations.

Finally, the proposed system is capable of supplying traffic density data to fixed data receivers, such as modem-connected personal computers and personal digital assistants.